World Ocean Circulation Experiment

NEWSLETTER

Number 13 October 1992

FEATURES

NEWS FROM THE WOCE-IPO

The WOCE International Project Office has undergone major staff changes during the past year. Since the departure in July 1991 of the previous Director, Dr Peter Koltermann, we have bid farewell to Dr Bruce Taft who returned to PMEL/NOAA after the WOCE-17 meeting last November. Dr Nick Fofonoff from Woods Hole Oceanographic Institution was welcomed as the new Director in October 1991. Bruce served as Acting Director during the intervening months after Peter's departure. In June 1992 we said our goodbyes to Bert Thompson, who has been associated with WOCE since its early beginnings. He served as Secretary to CCCO until 1987 and then as Staff Scientist at IPO. We hope to have him back at IPO during November to help us with preparations for the next SSG meeting, WOCE-19, scheduled for January 1993 at the James Rennell Centre in Southampton. Dr George Needler, who served as Director of IPO for 4 years, finished his term as WOCE Chief Scientist in June 1992. Dr Ilse Hamann arrived from Hawaii via Hamburg in July 1992 and plunged immediately into the busy IPO schedule. Among other duties, Ilse has taken on the task of editing the WOCE Newsletter.

Penny Holliday and Sheelagh Collyer are still with IPO and have had to take on additional responsibilities to cope with the reduction in staff. During the past year, we have participated in 22 meetings, issued 16 reports and distributed two newsletters.

Highlights in the WOCE Field Programme during 1992

As expected there has been a big increase of activity within the WOCE field programme this year, with some notable milestones being reached. On 10 August the TOPEX/POSEIDON satellite was launched and is now successfully collecting and transmitting data. Among the 10 WHP One-Time Survey lines completed so far in 1992 were the Columbus section A5, a cooperative effort between Spain and US, and the Pacific segment of S4,

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again a cooperative effort but this time between US and Russia. A Pacific line P6 was completed with the newly stretched R/V Knorr in a cooperative US/Australian programme. One other One-Time Survey line, A7, is due to be completed during the coming months of December and January. In addition to those 11 sections, a further 10 segments were completed which fall into the "supplemental" category of the WHP. A total of 57 occupations of WHP repeat lines and study areas have been done so far this year, with a further 3 due to be completed by the end of December. By the end of 1992, 11 current meter arrays will have been deployed, 4 of which are redeployments of previous arrays. There has been a huge increase in the numbers of floats and drifters deployed this year; around 240 floats and nearly 900 drifters compared to 84 floats and 500 drifters in 1991. The XBT coverage continues and sampling on some Pacific high density lines began.

UPDATE ON PROGRAMME GAPS

In Newsletter Number 12, February 1992, the WOCE major programme gaps identified by the SSG were listed together with initiatives aimed at improving these shortcomings in the field measurements. Noted below are reports on the status of the gaps and any new developments which have arisen.

Southern Ocean Choke Point Sections

No commitment for repeat hydrography across Drake Passage ("choke point" one) have been made. Interest for occupations has been expressed by Spanish, Brazilian and Chilean scientists for the repeats of SR1 however. The IPO strongly encourages the pursuit and consolidation of these tentative plans.

While mooring arrays SMC1 and SMC2 still require commitment to measure directly the flow through "choke points" one and two (Drake Passage and between Africa and Antarctica), highest priority has been placed on the augmentation of and coordination with the extensive array planned between Australia and Antarctica ("choke point" three).

Core Project 3

The CP3 process studies and Deep Basin Experiment are proceeding according to plan and with adequate resources. However the required commitments to the more extensive gyre- and basin-scale measurements have not been forthcoming. This component of CP3 has been delayed to the end of WOCE while major resources have been allocated to regional foci of CP1 and CP2. This delay means that the time period available to carry out the CP3 gyre scale measurements is now reduced to effectively two years 1996 and 1997.

It is not certain that, even with substantial resources allocated, in such a short time frame the CP3 objectives of observing the seasonal and interannual gyre-scale response will be achieved.

In view of the projected shortfall and the importance of these measurements to the validation and development of models, a major review of CP3 needs to be made by the CP3 WG and by the SSG at WOCE-19.

High Density XBT Sections

The Atlantic high density lines AX7 and AX16 were selected by CP1 to provide the best estimate of mass and heat transport across the subtropical gyres. The US has indicated they may begin sampling AX7 in 1993 if resources are available, but AX16 has no proposed coverage at all. In response to the situation, CP1 has designated AX18 as an alternative to AX16 and stresses the need for sampling to begin as soon as possible on this line.

Australia has proposed one occupation per year along IX15 and IX21, to be coordinated with further occupations by some other country along these lines. So far there has been little response to this suggestion, although France has indicated it may consider redistributing some probes from their TOGA stocks to provide XBTs for this route.

Because of the lack of commitment to the WHP repeat sections in the Indian Ocean, CP1 has designated five more XBT lines high density (IX1, IX3, IX6, IX10 and IX12). The request is for 2-4 high density occupations per year along these lines with a proportion of XCTDs along IX1, IX10 and IX12. So far there has been a limited response; Australia has proposed 2 occupations of IX1 per year with XCTDs every 500 km.

There is still no commitment for work on the heat flux section PX12A or PX12-PX29. PX14 which is needed for estimates of the variability of the heat and mass transport into and out of the eastern boundary regions, remains uncommitted.

The current commitments to PX5, PX10, PX37, PX38 and PX44 still fall short of the required 4 occupations each per year.

There is still no commitment to PX36 (New Zealand-Antarctica), but there are a number of Southern Ocean XBT/XCTD sections in progress or soon to begin, including occupations by Japan (IX23 and 150°E

section) and France/Australia (Hobart-Dumont d'Urville, Hobart-Antarctica at 110°E, Hobart-Macquarie Is.-Antarctica at 110°E). CP2 has strongly recommended supply ships be used to obtain XBT sections between New Zealand and the Ross Sea, and that XCTDs be used wherever possible (if proven sufficiently accurate and reliable).

South Pacific WHP Lines

Between February and April 1992 the first of the S4 segments along 66/67°S and between 70°W and 165°E was successfully completed on board the Russian R/V Akademik Ioffe. Now negotiations are underway for another US/Russian cooperative effort, *i.e.* the occupation of the southern ends of the meridional lines P14 and P15 in the southwestern Pacific. Already planned for 1994 is a joint WOCE/JGOFS cruise covering P15 (170°W) between 10°S and 65°S. This will be a US/Australian cooperative effort.

Western and North Pacific WHP Lines

Of the 11 WHP sections listed as uncommitted in the previous issue of the Newsletter, the following ones are now planned to WOCE standards (nations and dates are given in parentheses):

P1 (CIS, 1993), P2 (Japan, 1993), P9 (Japan, 1994), P26 (Republic of China, 1994), P27 (Republic of China/Philippines, 1993).

The remaining sections have also been planned, but at this writing still either fall short in their station density (nominally 30 nm) or lack the rosette capable of carrying 10 litre bottles required for the small volume tracer samples:

P8 (PRC, 1993), P11N (Japan, 1994), P11S (Australia, 1993), P25 (PRC, 1993), P28, P29, P30 (all by PRC, 1993).

The WHP Office has made efforts to assist scientists from western Pacific nations in upgrading their operations, and suggestions for accomplishing at least some of the latter set of sections to WOCE standards. These will be discussed at the WHP PC meeting this month (WHP-11, Hamburg, 26-28 October 1992).

Intermediate Depth Floats

While on average good coverage is expected for the intermediate floats, the necessary resources for CP3 studies in the Atlantic are still lacking. The multi-national EUROFLOAT experiment in the northeast Atlantic was not funded, which has serious consequences for essential basin-scale dynamical processes derived from Lagrangian velocity observations. This leaves only the Deep Basin Experiment reasonably well covered in CP3.

Staffing of WOCE Facilities

The shortages in staff at the WHPO, IPO and Indian Ocean Upper Ocean Thermal (UOT) DAC persist. A hydrographer is badly needed for the WHPO, without whom no data reports will be produced at the Office. Without provision for a hydrographer even in the 1993 budget, secondment appears to be the only option at this time. Data from 17 cruises in 1992 are being moved through the DQE process right now, and additional DQEs will be needed as the number of cruises increases. The IPO is now 2 persons short compared to the first half of the year. The Indian Ocean UOT/DAC will start operations in November 1992 with insufficient man-power. Additional funds are needed to start the DAC work. With some help regarding people-power the DAC intends to start processing the 1990 delayed mode data in February 1993.

The service of scientists in these and other operational units of WOCE is inherently short-term, as the organisational and managerial responsibilities exercised in these posts must not endanger the long-term research career of the individuals. It follows that recruitment and replacement for these operational as well as technical committees of WOCE is a crucial and on-going necessity. Apart from the fully funded secondment of scientists to the international offices, funds are sought for part-time support of available people.

Contingency funding for WOCE

No mechanism is in place to allow a reliable response to crises arising during the now active implementation phase of the WOCE field programme. Generally, the kind of problems that have been dealt with on an a*d hoc* basis so far, involved ten thousand dollars or more.

Possibilities to ensure funds for solving problems of this nature include:

- a percentage of the operational budget of WOCE is set aside as a contingency fund (*e.g.* 10%)
- a network of people working for national funding agencies assisting in a rapid assessment of available emergency resources on a case-by-case basis.

No progress has been made with the former approach, and the tapping of the latter "resource network" has had rather weak responses so far.

WOCE FIELD PROGRAMME EVENTS SCHEDULED FOR 1993

The schedule of events for 1993 is intended to show the various components of the WOCE field programme which are occurring in 1993 and, where appropriate, how they relate to each other. The first column contains the name or number of the "event", and the second column the location if it is different from, or not found in, the WOCE Implementation Plan (Volume 1: Detailed Requirements, July 1988, WCRP-11, WMO/TD No. 242). The final column lists associated deployments or sections.

The information for this schedule was obtained from the WOCE Data Information Unit (DIU), the WOCE Hydrographic Programme Office and other sources. Please let the WOCE IPO, the WOCE DIU and/or the WHP Office know of any omissions or updates.

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WOCE Field Programme Events Scheduled for 1993

27/10/92

Event	Location	Country	Chief Scientist (Institute)	Date	Deployments/Notes
Primary WHP One-Time Sections					
A6		France	Colin (ORSTOM Cayenne)	Jan 23 - Feb 16	
A7		France	Morlière (LODYC)	Dec 13 1992 - Jan 8	
A10		Germany	Onken (IfM Kiel)	Dec 28 - Jan 31 1994	ACM3
A11		UK	Saunders (IOSDL)	Dec 1992 - Jan	
A15		USA	Smethie (LDGO)	Mar 18 - May 3	
I4		France	Fieux (LODYC)	Aug	
I6		France	Poisson (LPCM)	Jan - Feb	
P1		CIS	Pokudov (DVNIGMI)		
P2		Japan	Ishii (HD, MSA)		PCM5
P8		PRC	Hu (AS)		Not to WHP OT requirements
P10		USA	Hall (WHOI)	Nov 3 - Dec 6	10 ALACE
P14N	Bering Sea-Midway	USA	Roden (U. Washington)	Jul 5 - Jul 28	12 ALACE
P14N	Midway-Fiji	USA	Roden (U. Washington)	Jul 30 - Sep 4	
P17N	San Francisco-Adak	USA	Musgrave, Royer (U. Alaska)	May 15- Jun 26	10 ALACE
P17E	53°S 135°W eastwards	USA	Swift (SIO)	Dec 3 1992 - Jan 22	ALACE, Drifters
P19N	88°W 54°S-Guatemala	USA	Talley (SIO)	Feb 22 - Apr 21	34 ALACE
P19S	54°S - 65°S	USA	Swift (SIO)	Dec 3 1992 - Jan 22	Drifters
P25		PRC	Hu (AS)		Not to WHP OT requirements
P27		ROC/PH	Liu (National U.)		
P28		PRC	Hu (AS)		Not to WHP OT requirements
P29		PRC	Hu (AS)		Not to WHP OT requirements
P30		PRC	Hu (AS)		Not to WHP OT requirements
P31		USA	Roemmich, Bray (SIO)	Sep	20 ALACE
Supplementary WHP One-Time Sections					
A16N	10°N-Iceland	USA	(NOAA/AOML)		
I1W	Africa-80°E	CIS	Golovastov (DVNIGMI)		
I7S	10°S-20°N	CIS	Nikitin (GOIN)		
I8S	S of 60°S	UK	Dickson (MAFF)	Feb 6 - Mar 19	SCM6
P11A	S of 45°S	Australia	Rintoul (CSIRO)	Apr 30 - May 20	
P11S	New Guinea-45°S	Australia	Rintoul (CSIRO)	Jun - Jul	
P13C	40°N-50°N	Japan	(Hokkaido U.)	May - Jun	
WHP Repeats					
AR4E	35°W 2°N-Brazil	France	Colin de Verdière (IFREMER)		
AR4W	44°W 10°N-S. America	France	Colin de Verdière (IFREMER)		
AR6		Germany	Siedler (IfM Kiel)		
AR7E	57°N Ireland-Greenland	Germany	Meincke (IfM Hamburg)	Jul 23 - Aug 16	
AR7E	57°N Ireland-Greenland	CIS	Doronin (AANII)		
AR7W	Greenland-Labrador	Canada	Lazier (BIO)		
AR8	Santos-Vema Ch.-50°W	Brazil	Ikeda (IOUSP)	Jan	8 Drifters
AR8		Germany	Siedler (IfM Kiel)		
AR9		S. Africa	Lutjeharms, Lucas (Capetown U.)	Oct	

Event	Location	Country	Chief Scientist (Institute)	Date	Deployments/Notes
WHP Repeats (continued)					
AR11		USA	Luyten (WHOI)	May 18 - Jun 17	
AR11		USA	Weller (WHOI)	Jun 9 - Jun 29	
AR13		Canada	Clarke (BIO)		
AR15		USA	Weatherly (FSU)	Mar 18 - May 3	
AR15		USA	Smethie (LDGO)	Mar 13 - May 3	
AR16		Spain/ Portugal	Perez (CSIC), Fuiza (U. Lisbon)		
AR18		DK, ICE, N, S	Buch, Malmberg (Farvandsvaesenet)		
IR4		Germany	Schott (IfM Kiel), Quadfasel (Ifm Hamburg)		
ISS1		UK	Dickson (MAFF)	Feb 8 - Mar 19	SCM6
ISS1		UK	Pollard (IOSDL)	Mar - Apr	
PR1		PRC	Pu (SOA)	Spring/Autumn	
PR2		Japan	Amino (JMA)	Jan and Jul	
PR3		Japan	Ishii (HD, MSA)	Feb	
PR3		Japan	Amino (JMA)	May and Nov	
PR3		PRC	Pu (SOA)	Spring/Autumn	
PR6		Canada	Whitney (IOS BC)	Jun	
PR11		Australia	Church (CSIRO)	Sep	
PR11		N. Zealand	Stanton, Chiswell (NZOI)	Mar and Sep	
PR12		Australia	Rintoul (CSIRO)	Mar 24 - Apr 13	
PR12		CIS	Koshlyakov (IOAN)		
PR13N	Tasmania-NZ	Australia	Church (CSIRO)	Jun and Dec	
PR13N	Tasmania-NZ	N. Zealand	Stanton, Chiswell (NZOI)	Mar and Sep	
PR17		PRC	Yaochu, Yeli (SOA)	Spring/Autumn	
PR18		Japan	Amino (JMA)		
PR18		PRC	Yaochu, Yeli (SOA)	Spring/Autumn	
PR19		Japan	Amino (JMA)		
PR19		PRC	Yeli (SOA), Hu (AS)	Spring/Autumn	
PR21		PRC	Pu (SOA)	Spring/Autumn	
PR22		PRC	Pu (SOA)	Spring/Autumn	
PR23		PRC	Pu (SOA)	Spring/Autumn	
PR24		PRC	Pu (SOA)	Spring/Autumn	
SR2		S. Africa	Lutjeharms, Lucas (Capetown U.)	Jan - Feb	
SR4		Germany	Fahrbach (AWI)	Dec 3 - Jan 22 1994	
Drifters					
-	Atlantic	Brazil			11 drifters (proposed)
AR8		Brazil			8
-	Atlantic	Germany			30 (drogued at 100 m)
-	Atlantic	NATO			20 (proposed)
-	Atlantic	NL	Otto (NIOZ)		5
-	Atlantic	Nord. Group			7-20 (interest expressed)
-	Atlantic	Portugal			30
-	Atlantic	UK			38 (interest expressed)
ACCP	North Atlantic	USA	(NOAA)		60
AR11	Subduction	USA			20 (plus 40 proposed)
-	Atlantic	CIS			20 (proposed)
AMMS	Indian	Japan			10
-	Indian	Australia			10
TOGA	Southwest Pacific	Australia	Cresswell (CSIRO)		13
	Pacific	Canada			30-40 (proposed)
TOGA	Pacific	France	du Penhoat (ORSTOM Noumea)		8 (proposed)
Kuroshio	Pacific	Japan	Imawaki (Kyushu U.)		5
WestPac	Western Pacific	Japan	Imawaki (Kyushu U.)		3
PCS	Pacific Circulation	Japan	Imawaki (Kyushu U.)		10 (proposed)
-	Northwest Pacific	Korea			5 (plus 21 proposed)
-	West Pacific	ROC/USA			36
-	Mid Latitude Pacific	USA	Niiler (SIO)		102 (proposed)
TOGA	Equatorial Pacific	USA	Niiler (SIO)		125
CCP	California Current	USA			54
-	Northwest Pacific	USA/CIS	Maksimenko (P.P. Shirshov)		17 (plus 80 proposed)
-	Southern	Argentina			5
-	Southern	Australia	Cresswell (CSIRO		8 (proposed)
-	Southern	USA			180 (proposed)
				Total	1024 (incl. prop. & interest)

Event	Location	Country	Chief Scientist (Institute)	Date	Deployments/Notes
Moored Arrays					
ACM3		Germany	Onken (IfM Kiel)	Dec 28 - Jan 31 1994	On A10. Recover moorings deployed in 1991
ACM6		Canada	Clarke (BIO)		
ACM9		Spain	Ruiz Canabate (IHM)		Gibraltar Expt. Redeploy in 94, 95
ACM13		Germany			
PCM1		USA/ROC/ J/PRC			7 moorings, 31 CMs, 3 ADCPs, 9 IES
PCM5		Japan	Imawaki (Kyushu U.), Ichikawa (Kagoshima U.)		On P2. Redeploy in 1994
PCM6		USA			9 moorings, 27 CMs
SCM3		USA/ Australia	Church, Middleton (CSIRO)	Mar	9 moorings, 25 EF sensors. Recover 1995/6
SCM6	ADOX	UK	Dickson (MAFF)	Feb/Mar	2 arrays; Crozet-Kerguelen (10 moorings, 42 CMs) and Princess Eliz. Trough (6 moorings, 15 CMs)
Floats					
Med. Outflow	North Atlantic	USA	(WHOI, SIO)		40 RAFOS
-	North Atlantic Current	USA	(U. Rhode Is.)		100 RAFOS
AR6		Germany			26 RAFOS
SAMBA	Brazil Basin	France	(IFREMER)		25 RAFOS
DBE	AR15	USA			50 RAFOS
-	North Pacific	USA	(U. Washington)		30 RAFOS
-	North Pacific	Japan	(JMA)		3 RAFOS
-	North Pacific	Canada	Freeland (IOS BC)		? RAFOS
SR3	150°E 43°S-60°S	USA	Davis (SIO)	Jan	7 ALACE
P19N	88°W, 54°S-14°N	USA	Davis (SIO)	Feb 23 - Apr 22	34 ALACE
P17N	San Francisco-Alaska	USA	Davis (SIO)	May	10 ALACE
P14N	175°E, 18°S-20°N	USA	Davis (SIO)	Jul	12 ALACE
P31	Fiji-Tahiti	USA	Davis (SIO)	Sep	20 ALACE
P10	145°W, 5°S-20°N	USA	Davis (SIO)	Nov	10 ALACE
A21/S1	Drake Passage	USA	Davis (SIO)	Dec	8 ALACE
				Total	385
High Density XBT Lines					
AX7		USA	Szabados (NOAA/NOS)		
PX6/9		USA	Roemmich (SIO)	4 times	
PX10		USA	Roemmich (SIO)	2 times	
PX12A		USA/Chile	Talley (SIO), Espinoza (Chile Navy)	2 times	
PX31	Sydney-Noumea	USA	Roemmich (SIO)	4 times	
PX31	Sydney-Noumea	Australia	Meyers, Bailey (CSIRO)	2 times	
PX34		Australia	Meyers, Bailey (CSIRO)	4 times	
PX37		USA	Roemmich (SIO)	2 times	
PX44		USA	Roemmich (SIO)	2 times	

XBT lines with Low Density coverage in 1993

AX1	AX10	IX1	IX14	PX2	PX12A	PX25
AX2	AX12	IX2	IX19	PX3	PX13	PX26
AX3	AX14	IX3	IX21 HD	PX4	PX14 HD	PX29 HD
AX4	AX15	IX6		PX5 HD	PX17	PX38 HD
AX5	AX20	IX9		PX8	PX18	PX47
AX8	AX27	IX10		PX11	PX20	PX49
AX9		IX12		PX12 HD	PX21	

CHANGES TO THE WOCE IMPLEMENTATION PLAN

As WOCE moves further into the intensive observation phase the requirements of the field programme as laid out in the Implementation Plan (Volume 1, Detailed Requirements) come under scrutiny. Changes to elements of the field programme may need to be made for practical and/or scientific reasons. If a particular component is lacking in commitment, then another component may need to be modified to make up the shortfall; knowledge gained from work carried out already may point to a change in a section to obtain maximum information.

The changes listed here have all been approved by the relevant Core Project Working Groups either at their meetings or as a result of an exchange over telemail. The right hand column indicates the working group meeting (or date of exchange) when the modification was approved. Please refer to the reports of these meetings for further information about the changes.

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WOCE International Project Office, September 1989: Report of the Second Meeting of the WOCE Core Project 1 Working Group, CP1-2, Dartmouth, NS, Canada, 19-21 April 1989. 18pp. WOCE Report No. 35/89

WOCE International Project Office, June 1990: Report of the Third Meeting of the WOCE Core Project 1 Working Group, CP1-3, Hobart, Tasmania, Australia, 9-11 April 1990. 18pp. WOCE Report No. 53/90

WOCE International Project Office, August 1991: Report of the Fourth Meeting of the WOCE Core Project 1 Working Group, CP1-4, Scripps Institution of Oceanography, La Jolla, CA.92093, USA, 3-5 April 1991. 20pp. WOCE Report No. 75/91

WOCE International Project Office, October 1991: Report of the Fourth Meeting of the WOCE Core Project 3 Working Group, CP3-4, Woods Hole Oceanographic Institution, Woods Hole, MA.02543, USA, 11-13 February 1991. 76pp. WOCE Report No. 76/91

WOCE International Project Office, November 1991: Report of the Fourth Meeting of the WOCE Core Project 2 Working Group, CP2-4, Salle de Conseil, Institut Oceanographique, Paris V, France, 13-16 March 1991. 32pp. WOCE Report No. 70/91

WOCE International Project Office, September 1992: Report of the Fifth Meeting of the WOCE Core Project 2 Working Group, CP2-5, Scripps Institution of Oceanography, La Jolla, CA.92093, USA, 13-15 April 1991. 22pp. WOCE Report No. 86/92

WOCE International Project Office, (Unpublished): Report of the Fifth Meeting of the WOCE Core Project 1 Working Group, CP1-5, Vancouver, Canada, 29 April - 1 May 1992. ??pp. WOCE Report No. ??/92

Changes in Details of the Implementation Plan

27/10/92

Event	Location in Implementation Plan (1988)	Revision	Meeting and Date
WHP One-Time Survey			
A6	5°N - Africa to South America	Relocate to 7°30'N; subject to informing PIs on A15, A17, AR17	CP1-5 April 1992
A8	13°S - Africa to South America	Relocate to 11°S	CP1-5 April 1992
A13	0 - Africa south to 65°S	Relocate to the east to 5-10°E	CP1-4 April 1991
A14	14°W - Africa south to 40°S, to 53°S 0	Relocate to 9°W - Ivory Coast to 45°S	CP1-4 April 1991
A17	5°N 32°W south to 21°S 32°W then to 45°S 54°W	Extend to Antarctica (extension replaces A19). Short sections from Argentine coast out to A17 at 45°S and further north (AR8) should be included	CP1-4 April 1991
A17S	45°S 54°W to Antarctica	Delete; replaced by repositioned SR1	CP1-5 April 1992
A19	50°W - S. America to Antarctica	Delete; replaced by A17 extension	CP1-4 April 1991
I4	25°S between Africa and Madagascar	Relocate to 15-16°S (narrowest point)	CP1-2 April 1989
P2	35°N	Relocate to 30°N; designated primary heat flux line	CP1-4 April 1991
		Western end changed to coincide with PCM5, crossing the Kuroshio at a right angle south of Shikoku, Japan. Portion across East China Sea deleted	CP1-5 April 1992
P6	28°S	Relocate to 32°S; replace P22 and overlay PCM9 array	CP1-4 April 1991
P11	155°E. Japan to Solomon Is.	Extend; 155°E Japan to Solomon Is. to Antarctica	CP1-2 April 1989
P13	165°E to 7°S, 160°E in S. Pacific	Shorten; 165°E south to New Caledonia	CP1-2 April 1989
P14	175°E, 170°E south of New Zealand	Relocate; 179°E Bering Sea to New Zealand, 170°E to 73°S or to ice edge	CP1-3 April 1990,
		P14N, turn NNE in Bering Sea	CP1-4 April 1991
P15	170°W	Relocate; 165°W	CP1-4 April 1991
P17	130°W south to 57°S then east to Cape Horn	Adak to San Francisco; 135°W, 35°N to 57°S; east to Cape Horn	
P20	15°S Australia to 165°E	Relocate to 17°S Australia to 5°S 165°E	CP1-2 April 1989
P21	Australia at 24°S to Fiji 10°S 162°W and west to 175°W	Relocate; Australia at 24°S to Fiji, west along 17°S to S. America	CP1-2 April 1989
P22	East Cape NZ to 33°S 168°W	Delete; made redundant by repositioning of P6	CP1-4 April 1991
P23	South Is. NZ to 64°S 168°W	Delete	CP1-3 April 1990
WHP Repeats			
AR4	40°W 10°N to Brazil	Two lines, 35°W, 2°N - 5°S and 44°W, 10°N - 2°S	CP1-4 April 1991
AR7E	57°N. Ireland to Greenland	Track must cross major topographic features as nearly as possible orthogonally	CP3-4 February 1991
AR18		Create line; north of Denmark Straits and Iceland-Faroe Ridge	CP1-5 April 1992
ISS1	Southwest Indian Ocean	Extend eastern boundary to 75°E for better coverage of SW Indian Gyre.	CP2-5 April 1992
		Move northern boundary to 32°S to reduce total area and coincide with WHP line I5	
ISS2	Northwest Indian Ocean	Extend boundaries to include northern half of the Arabian Sea	CP1-2 April 1989
ISS3	Eastern Indian Ocean, Indonesia to Australia	Extend to the east right up to the Indonesia passages	CP1-3 April 1990
PR5-6	Two lines, Canada to OWS Papa	Delete PR5, the northern section	CP1-3 April 1990
		Reinstate PR5; occupied by Canada twice a year	CP1-5 April 1992
PR7-8	Two lines, Alaska to OWS Papa	Delete PR7, the western section	CP1-3 April 1990
PR9-10	Two lines, USA to OWS Papa	Delete PR9, the northern section	CP1-3 April 1990
PR11	28°S from Australia to 178°E, south to NZ	Follow alignment of P6 (32°S) until intersection with P14	CP1-2 April 1989

Event	Location in Implementation Plan (1988)	Revision	Meeting and Date
WHP Repeats (Cont'd)			
PR14	Eastern South Pacific	Relocate to 35°S and 47°S	CP1-3 April 1990
PR23	7.5°N from Mindanao to 130°E	Designate shallow section, Mindanao - 130°E	CP1-4 April 1991
PR25		Create lines; 12°S, 9°S, 5°S off Peru coast out to 200 km	CP1-3 April 1990
PR26		Create line; Mindanao to 165°E then south along 165°E	CP1-4 April 1991
SR1	64°W. S. America to Antarctica	Relocate; south central Burdwood Bank to Elephant Is.	CP2-5 April 1992
WHP Time Series Stations			
PRS3	24°N 115°W	Move northward to California coast	CP1-4 April 1991
PRS9		Create station; 58°N 147°W seaward of Alaska current	CP1-4 April 1991
SRS1		Create station; 50°S 68°E, south of Kerguelen Is.	CP2-4 March 1991
Current Meter Moorings			
ACM7	10°N 50°W	Relocate to 0 44°W	CP1-4 April 1991
ACM10	4°N 40°W. Ceara Rise	Relocate to 0 37°W	CP1-4 April 1991
ACM16	Brazil Current to interior of S. Atlantic subtropical gyre	Delete; subsumed in ACM23	CP1-5 April 1992
ACM17	Higher latitude. S. Atlantic	Delete; subsumed in ACM4	CP1-5 April 1992
ICM3	20°S and Madagascar. Indian Ridge. 90°E	Relocate to east of Madagascar	CP1-3 April 1990
ICM5	8°S 42°E. East Africa	Relocate to 15°S 42°E, narrowest point	CP1-3 April 1990
ICM6	8°S 102°E. West of Sumatra	Relocate to 20°S 118°E, eastern end of section I3	April 1990
PCM1	24°N 125°E	Supported as the optimal location for Kuroshio transport measurements	CP1-4 April 1991
PCM2	24°N 11°5W	Relocate to eastern end of P2 (30°N). Eastern boundary array for heat flux line	CP1-4 April 1991
PCM5	Vicinity of Japan	Redesignate as western boundary current array for N. Pacific heat flux line (P2)	CP1-4 April 1991
PCM9	37°S 170°W. Chatham Rise (Incorrect location)	Along 32.5°S for 100 km east from 179°W	CP1-2 April 1989
PCM14	35°S 75°W	Delete; requirements covered by PCM4	CP1-3 April 1990
PCM15		Create array; NE coast of Papua New Guinea	CP1-3 April 1990
XBT Sections			
All Lines	Various	Renumbered to provide a standard for TOGA, WOCE & IGOSS (IPO has further details if required)	Telemail April 1990
AX7	Gulf of Mexico - Gibraltar	Upgrade to high density and high priority	CP1-4 April 1991
AX16	Rio - Walvis Bay	Upgrade to high density and high priority	CP1-4 April 1991
		Revert to low density only; replaced by AX18	CP1-5 April 1992
AX18	Buenos Aires - Cape of Good Hope	Upgrade to high density and high priority (heat transport section)	CP1-5 April 1992
IX1	Fremantle - Sunda Strait	Upgrade to high density (2/year); XCTD coverage at low density	CP1-5 April 1992
IX2	Cape of Good Hope - Fremantle	Upgrade to high density	CP1-3 April 1990
IX3	Red Sea - Mauritius/La Reunion	Upgrade to high density (2/year)	CP1-5 April 1992
IX6	Mauritius/La Reunion - Malacca Strait	Upgrade to high density (2/year)	CP1-5 April 1992
IX10	Red Sea - Malacca Strait/Singapore	Upgrade to high density (4/year); XCTD coverage at low density	CP1-5 April 1992
IX12	Fremantle - Red Sea	Upgrade to high density (2/year); XCTDs at low density in tropics	CP1-5 April 1992
IX15	Mauritius - Fremantle	Upgrade to high density and high priority	CP1-4 April 1991
IX21	Cape of Good Hope	Upgrade to high density and high priority	CP1-4 April 1991

SPECIAL STUDIES IN THE INDIAN OCEAN

As the Pacific WHP survey approaches its final phase in 1993-94, the WOCE programmes in the Indian Ocean are spinning up. Preparatory discussions held mainly in 1991 resulted in 'The Program Design for the Indian Ocean', a report written by the US WOCE Office with input from the oceanographic community. This design of a coordinated expeditionary programme outlines the US contribution to WOCE Core Project 1, and is presently under review by the US Interagency Panel (IAP) for WOCE. Within the projected duration of the US Indian Ocean Programme of approximately 14 months (November 1994 through 1995), all one-time hydrographic sections except I5C, I6 and I7S (*i.e.* south of I5) are to be occupied. I6 and I7S are planned to be done by France in 1993 and 1995 (see Table 2), while British oceanographers are hoping to occupy the central portion of I5.

To cover adequately regions of high variability, one part of Core Project 1 consists of developing plans to survey such regions. In the Indian Ocean the Special Studies consist of

- the Agulhas recirculation regime (ISS1)
- the Somali/Arabian Sea regime (ISS2)
- the Pacific/Indian Ocean throughflow regime (ISS3)

As chair of the working group for WOCE Indian Ocean Special Studies, D. Olson assembled contributions from members of this group into another report, which documents the science issues on which work in one of the three special regions, ISS2, will focus (Indian Ocean Special Studies 2 ISS-2, draft from July 1992, see list of contributors at the end of this article). The approximate locations of the special study regions are outlined in Fig. 1.

In the US the decision was made early on to concentrate on Special Studies site 2 (ISS2) in the northwestern Indian Ocean. ISS2 covers the Somali/Arabian Sea Regime and its area is enclosed by the I2, I7, and I1 lines in the south and east, and by the African, Arabian and Indian coasts in the west and north. The focus on ISS2 followed from the fact that there had been recent efforts in the ISS3 region and that others are planned in the near future. It was felt that any further investigations there should await the results of this work. While the group was of the opinion that the ISS1 area falls in a region between WOCE Core Project 1 and 2 and coverage of WHP lines in the 1994-95 time frame would be incomplete, a plan for this region has since been presented by R. Pollard which invites optimism that a timely, multinational survey of ISS1 may be completed by the end of 1995 as well (see ISS1 plans outlined farther down).

Since the main rationale for the Special Studies originally was to cover major regions of variability, water mass modification and exchange, ISS2 can be primarily summarised as a programme to expand the WHP coverage such that the influences of the reversing monsoon forcing in the Somali and Arabian Basins can be categorised.

With this goal in mind the group discussed the background of what is known of the region and the seasonally variable conditions there. These are found in a series of short descriptions in the body of the report. Using these and WHP plans as a starting point the group suggests the following:

- an Arabian Sea array to discern the nature of air-sea interaction and the nature of the interior ocean response in the northern Arabian Sea.
- a similar array along the Somali coast at approximately 8°N to cover the monsoon driven cycle in the Somali Current.
- a mid-basin array to consider the connection of the mid-basin flows to the changes observed at the two sites above.
- an equatorial array to close the set of equatorial measurements done in the Pacific and Atlantic basins.
- repeat hydrography along the WOCE WHP lines in the alternate monsoons.

The exact details of each mooring component remain to be specified by proposing groups. The basic idea would be to complete at least one monsoon cycle with these deployments. Repeat hydrography, in alternate seasons with respect to the WHP sampling, allows treatment of variations in water masses along these lines tied to reversals in the monsoon forcing. As reoccupation of these lines requires a minimum effort, the suggestion would be to also fill in with additional hydrographic coverage where possible. Much of the final scope of ISS2 will depend on the exact nature of various contributors and the success in obtaining funds for implementation of ISS2.

Several initiatives aimed at contributing to ISS2 are currently underway. These include an effort initiated by US ONR support on Forced Upper Ocean Dynamics in the Arabian Sea. German plans might include some of the Somali work. A letter of intent has been filed within US NOAA concerning a repeat hydrographic effort. The JGOFS process study planned for the Arabian Sea in 1994-95 includes both a set of moorings and additional hydrography. Finally, there is planning as part of US GLOBEC to survey the North Indian Ocean (US GLOBEC Indian Ocean Planning Document, in preparation, to be published early 1993). This leaves the equatorial array and the mid-basin programme unaccounted for at the present writing. Other national WOCE programmes in the Indian Ocean in the time frame 1993-95 include French, Russian, German, British, and Australian expeditions. Some of the efforts that support and will be supported by ISS2 work are summarised in the report, as well as a set of strawman activities whose implementation are required for a successful ISS2. Areas

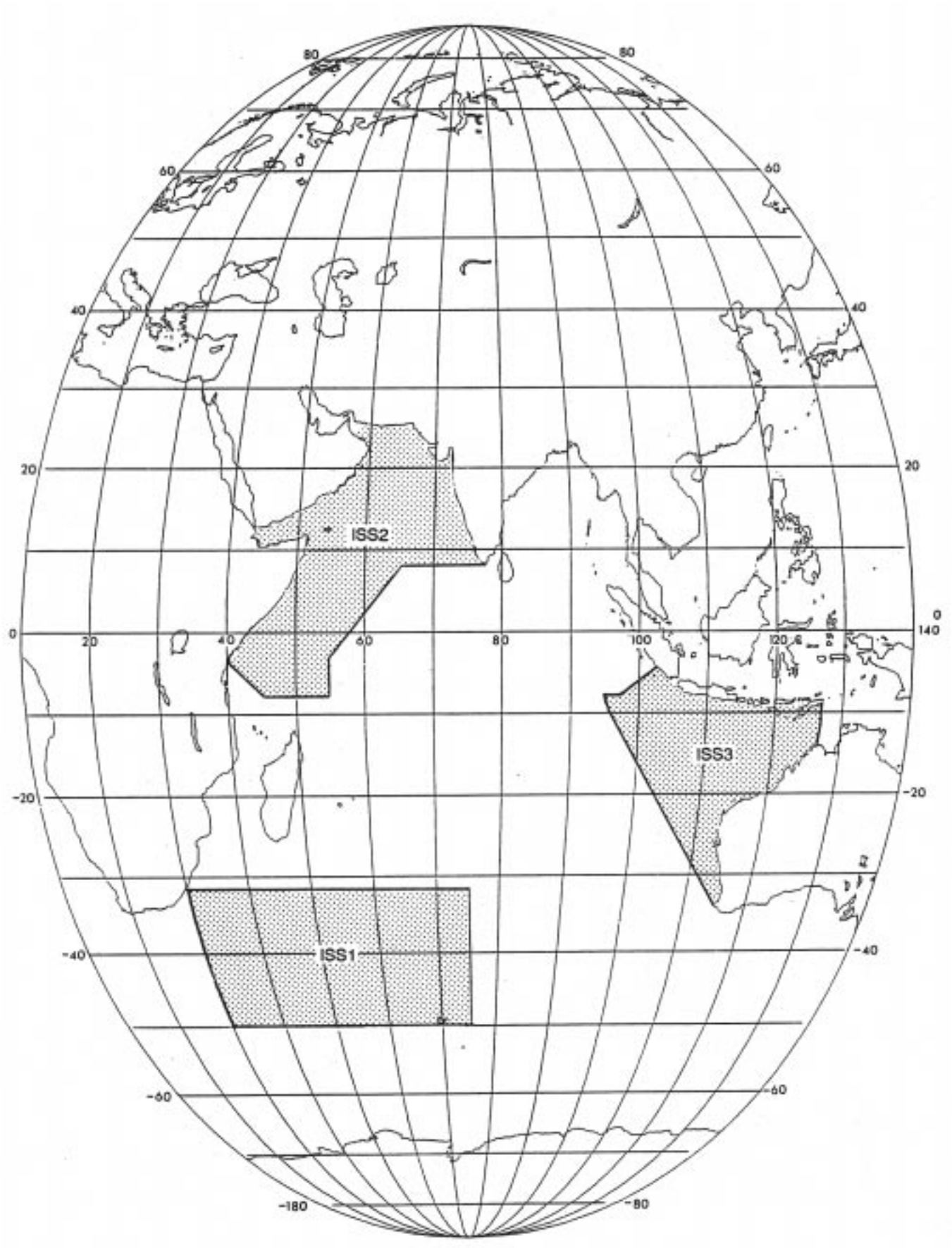

Figure 1. Special Studies Areas in the Indian Ocean (ISS1 revised)

Table 1. Observations in ISS1 Area Since 1987

Description	Date	PI/Country	Ship
CTD and SeaSoar sections 24°-52°S Mauritius to Crozet Plateau	December 86/January 87	Pollard/UK	Discovery
SCARC CTD/XBT survey of Agulhas Retro-flection	January/February 87	Lutjeharms/SA	
INDIGO III tracer sections 30°E (Antarctica to S. Africa) and Agulhas Bank to Kerguelen	January/February 87	Poisson/France	Marion Dufresne
CTD and SeaSoar sections in Agulhas Retro-flection. Recover 2-year moorings	February 87	Luyten/USA Pollard/UK	Discovery
CTD tracer section along 32°S (I5)	August 87	Toole/USA Warren/USA Fine/USA	Darwin
CTD section 30°S, S. Africa to Mauritius	September 87	Gründlingh/SA	Meiring Naudé
CTD section 30°S to Antarctica	February/March 88	Babu/India	Thuleland
SUZIL CTD sections in Crozet Kerguelen Amsterdam area	April/May 91	Park/France	Marion Dufresne
Study eddy shedding across STC between Capetown and Prince Edward Islands	April/May 91	Lucas/SA	Agulhas

Table 2. Proposed Observations in ISS1 Area 1992-1995

Description	Date	PI/Country	Status
Occupy I6, 30°E, to WOCE standards	January/February 93	Poisson/France	scheduled
ADOX. Deploy 10 moorings across Crozet-Kerguelen and 6 in Princess Elizabeth Trough. CTD and CFC sections	February 93	Dickson/UK	scheduled
SWINDEX. Deploy 8 moorings along 45°S between Agulhas Plateau and Crozet. CTD sections Cape Town to Crozet Plateau and south of Crozet Plateau	March/April 93	Pollard/UK	scheduled
XBTs La Réunion to 49°S, CTDs along I7S, south of 49°S along 55°E	March/April 93	Park/France	approved
ADOX mooring recovery	February 94	Dickson/UK	approved
Cape Town to Marion Island	April 94	Lutjeharms/SA	preliminary
SWINDEX mooring recovery and survey of Agulhas Return Flow north of Crozet Plateau	late 94	Pollard/UK	preliminary
Occupy I7S, 55°E, to WOCE standards	January/February 95	Poisson/France	approved
CTD box 32°S (I5) from S. Africa to 55°E (I7) up to Mauritius	mid 95	Toole/USA	preliminary

of special emphasis here are:

(1) the nature of the mixed layer and thermocline responses to the monsoon forcing;
(2) the nature of the cross equatorial exchange in the basin;
(3) the role of the eddy field in the transport of properties in the Somali and Arabian Basins; and
(4) the dynamics of the deep and intermediate circulation in these Basins.

An overview of results of model simulations of the region's circulation is also given.

The special study region in the southwest Indian Ocean (ISS1) was chosen for its vital role in ventilating the thermocline and the strong eddy/mean flow interactions believed to take place there (see R. Pollard's summary of plans published in CP2-5 report, September 1992). ISS1 is bounded by 32°S latitude (from South Africa to 75°E), 75°E, 50°S and 30°E (see Fig. 1).

Sampling in this dynamically critical area will be enhanced in comparison to standard Goal 1 coverage, as indications exist that the parameterisation of processes active here have a particularly crucial influence on model results. In this context the objectives of Core Projects 1 and 3 merge, as it becomes important to quantify dynamical balances and specify small-scale processes.

Results from cruises that crossed ISS1 during 1987 include enhanced ventilation of intermediate waters in the Crozet Basin inferred from elevated F-11 values compared to those of the eastern South Indian Ocean (see Table 1 and Table 2 for completed and planned expeditions respectively). A mechanism apt to contribute to the mixing and ventilation processes is the instability of the strong Agulhas Return Flow east of 45°E. Water masses participating in the ventilation are Subtropical Mode Water from the Agulhas Gyre and Subantarctic Mode Water formed north of the Antarctic Polar Front. The expected time variability of the Agulhas Current which impacts on the ventilation process needs to be monitored by the moored array (ICM1) originally suggested within this current at the western end of I5. However, no commitment so far exists for ICM1. During the last Core Project 2 meeting (CP2-5, 13-15 April 1992) it was strongly recommended that nations recovering ISS1 moorings consider redeploying them at the ICM1 location.

The earlier cruises also showed the Crozet Basin to be the site of inflow of deep and bottom water into the Indian Ocean. For the delineation as well as quantification of the water exchange between the circumpolar region and the southern Indian Ocean it is important that the whole length of the I5 section be occupied as it represents the northern boundary of the Indian Ocean sector of the Southern Ocean. Therefore it remains a serious concern in the design for ISS1 and the Southern Indian Ocean WOCE survey in general that the central section of I5 lacks commitment (between 55°E and 85°E) during the 1993-95 period. The western and eastern ends of this zonal section will be occupied by US vessels around mid-1995.

Data from the third special study region (ISS3, the Pacific/Indian throughflow) are now being evaluated in detail, and new plans will evolve from the results and reported in a future issue of this newsletter.

List of contributors to the report on Indian Ocean Special Studies 2:

Members	Representatives
Donald B. Olson, Chair	Stuart Godfrey, CCCO
Rana Fine	Peter Birkill, JGOFS
Mark E. Luther	Bruce Taft, IPO
Robert Molinari	
Fritz Schott	
John Swallow	
Bruce Warren	
Robert Weller	

New Location for Drake Passage Section

At the fifth meeting of WOCE Core Project 2 (13-15 April 1992) the Working Group recommended that the Drake Passage Repeat Hydrography line SR1 be relocated. The original line is logistically difficult because of the distance from routine UK supply runs between the Falkland/Malvinas Islands and BAS bases, and because of territorial considerations. The new track avoids territorial waters, known kinks in the ACC, is conveniently accessible for repeat hydrography, and coincides with a ground track of the ERS-1 satellite. The report of CP2-5 (WOCE Report No. 86/92) contains a more detailed description of the reasoning behind the relocation.

The new SR1 line runs between the south-central Burdwood Bank and Elephant Island. Approximate end points are at 54.98°S, 58.38°W and 60.68°S, 54.72°W which are suggested locations of bottom pressure gauges. The requirement for at least annual occupation of the new SR1 line to WOCE repeat hydrography standards remains unchanged.

A PILOT STUDY FOR PCM1-2 STARTED

Japanese and Chinese scientists cooperatively began direct current measurements, which could be a pilot study for the WOCE PCM1-2 array in the western North Pacific. They deployed seven current meters at three stations on the eastern slope of the Ryukyu Ridge (southeast of Okinawa) in November 1991. Those meters have recently been recovered in September 1992. Geostrophic transport will be estimated from CTD data obtained referenced to the measured velocities during the recovery cruise.

The Kuroshio is the western boundary current of the North Pacific subtropical gyre, but recent studies suggest that it might not represent the entire western boundary current; a part of the western boundary current might be flowing east of the Ryukyu Ridge. For example, seasonal fluctuation of measured transport of the Kuroshio in the East China Sea (between the East Taiwan Channel and the Tokara Strait) is considerably different from fluctuation of transport of the western boundary current estimated theoretically from observed seasonally fluctuating wind stress over the North Pacific[1][2]. The East China Sea is partly separated from the North Pacific Basin by the Ryukyu Islands and Ryukyu Ridge, and a considerable amount of water might be flowing east of the ridge as a branch of the western boundary current. Previous hydrographic observations, however, have not shown any remarkable seasonal currents east of the Ryukyu Ridge. It might be due to expected barotropic structure (or weak baroclinicity), which cannot be estimated by the conventional dynamic calculation[2]. Recent studies using inverse methods suggest that there seems to be a weak northeastward flow in the upper 1,000 m layer east of the Ryukyu Ridge[3].

Direct current measurements have been rarely carried out in this region. Exceptions were surface velocity measurements with surface drifters, deep and bottom velocity measurements with moored current meters[4], and in February 1992, scientists of the Japan Meteorological Agency carried out an ADCP section (and XBT) along the line of moorings OA, OB, OC with R/V Ryofu-maru.

Current measurements southeast of Okinawa with a moored array of current meters were planned in order to investigate velocity field on the eastern side of the Ryukyu Ridge, especially to answer the question whether there exists a barotropic steady flow. The location of the mooring site was chosen by following reasons: (a) the site is located in the middle of the Ryukyu Ridge and flows there seem to be less variable in time and space; (b) a moored array of ADCPs (Acoustic Doppler Current Profilers) and current meters, which had been maintained by Kyushu University to measure the Kuroshio in the East China Sea, is located at the northwestern extension of the present observation line; (c) the site is located outside of US Navy training areas (the eastern part of the WOCE repeat hydrographic section PR18 was another favourite candidate, but it is located inside of a training area); and (d) the results can be combined with results from IES (Inverted Echo Sounder) and moored current meter measurements, which are being carried out cooperatively by Kagoshima University and Rhode Island University to monitor the Kuroshio on the WOCE PR18 line in the East China Sea, in order to study the fluctuation of the entire western boundary current.

The present measurements could be a pilot study for the WOCE moored array PCM1-2. The moored array PCM1 is designed to measure the structure and variability of the transport of the western boundary current of the North Pacific subtropical gyre at about 25°N. The array PCM1 consists of PCM1-1 and PCM1-2; PCM1-1 located at the East Taiwan Channel is designed to measure the Kuroshio, and PCM1-2 located southeast of Okinawa is designed to measure the flow east of the Ryukyu Ridge[5]. Although the present array may not satisfy the requirement of the PCM1-2 array, it will provide us with valuable information about the flow field in this area.

This study is being carried out cooperatively by Japanese and Chinese scientists. Japanese scientists include Kenzo Takano (University of Tsukuba; Japanese Principal Investigator), Kazuo Kawatate and Shiro Imawaki (Kyushu University) and Hiroshi Ichikawa (Kagoshima University). Chinese scientists include Yaochu Yuan (Second Institute of Oceanography, State Oceanic Administration; Chinese Principal Investigator) and Jilan Su (Second Institute of Oceanography, SOA). The purpose of this cooperative work is for Japanese and Chinese scientists to jointly study the Kuroshio in the East China Sea and the current east of the Ryukyu Ridge, and also for Chinese people to learn the mooring technology including deployment and recovery operation of moorings on this occasion.

Current meters were deployed on board the R/V Shijian (95 m long) of the State Oceanic Administration, China. The Shijian made a port call at Nagasaki, Japan, where mooring equipment was loaded and Japanese scientists and technicians embarked. She left Nagasaki on 1 November 1991. Current meters were deployed at Station OA on 3 November and Station OB on 4 November (see Figure 1). No mooring work was able to be done from 5 November through 12 November because of bad weather due to the effects of Typhoons Nos. 24 and 26. Current meters were deployed at Station OC, the last station in this cruise, under strong wind and rough water conditions on 13 November. The R/V Shijian returned to Shanghai on 16 November, two days later than originally scheduled. Actually, five moorings were planned to be deployed originally: four on the east slope of the Ryukyu Ridge and one at a shallow gap of the ridge southwest of Okinawa. But,

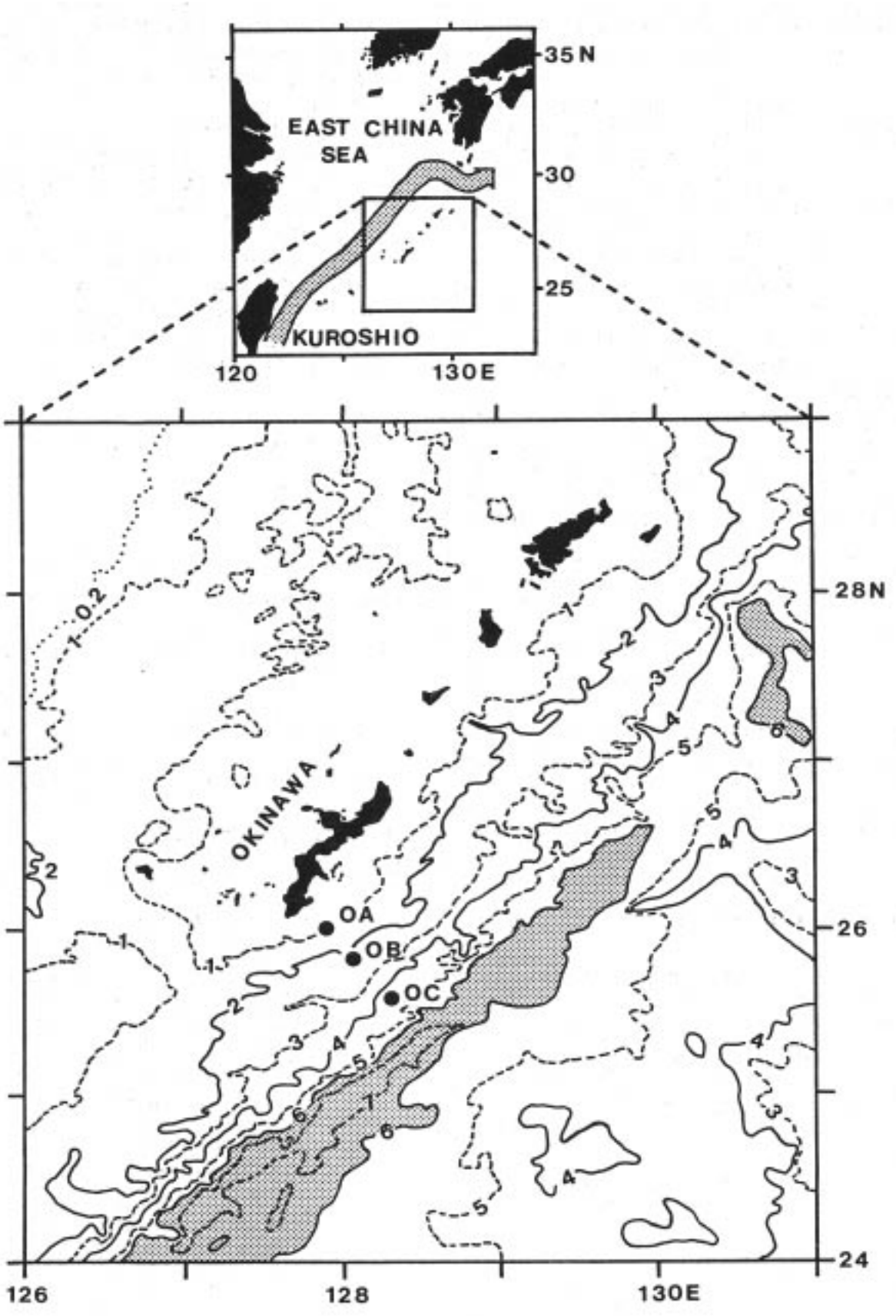

Figure 1. Map showing mooring locations. Depths are shown in km; shading indicates depths greater than 6 km.

only three moorings were able to be deployed actually. Young scientists and technicians of the Second Institute of Oceanography, SOA were willing to carry out the work. Especially, the last mooring at Station OC could not have been deployed without their enthusiastic support.

Table 1 shows mooring locations, water depths, current meter depths and dates of deployment. Current meters used are the Aanderaa current meter model RCM-5 with a temperature sensor. The shallowest current meter at each station is equipped with a pressure sensor, which detects vertical motions of the mooring line and gives us estimates of its horizontal motions.

Those moorings were recovered by the Chinese research vessel Shijian in September 1992. So far, no moorings are planned to be deployed again at those stations. A CTD section was carried out along the line of moorings during the recovery cruise.

In the present measurements, current meters were not able to be moored in the surface layer because of technical difficulties. Velocities measured at the middle and deep layers will provide us with valuable information about a barotropic steady flow which might exists in this region. These measured velocities alone, however, can not give us accurate estimates of the transport of the flow. The most practical way to accurately estimate the transport is to carry out CTD/XBT sections along the current meter stations during the observation period and to estimate geostrophic transport referred to those measured velocities.

Scientists involved in this programme are looking for persons who are planning to visit near this area and may have a chance to carry out CTD/XBT sections along those stations by summer or fall of 1992. Their sections and the CTD section to be done in the recovery cruise will provide us with a fairly good data set describing fluctuation of the geostrophic transport referred to those observed velocities at mid-depths. Anyone who is interested in this programme is asked to contact Shiro Imawaki [Omnet: S.IMAWAKI; Fax: 81-92-584-2570].

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Table 1. Mooring summary

Stn.	Lat. N	Long. E	Depth (m)	Current meter depth (m)	Deployment date
OA	25-58.6	127-53.7	1,000	570, 870	3 November 1991
OB	25-48.0	128-03.4	2,030	600, 1,900	4 November 1991
OC	25-33.6	128-19.5	4,610	680, 1,980, 4,480	13 November 1991

Depths were estimated from uncorrected readings of the onboard depth recorder.

References and Notes

[1] e.g., Greatbatch, R.J. and A. Goulding (1989) Seasonal variations in a linear barotropic model of the North Pacific driven by the Hellerman and Rosenstein wind stress field. *J. Geophys. Res.*, 94(C9), 12,645-12,665; another issue is that estimates of wind stress, which drives numerical models, are crude. (Kubota, M.; personal communication, 1991).

[2] Sekine, Y. and K. Kutsuwada (1990) A numerical experiment for the seasonal variation in volume transport of the Kuroshio south of Japan. *J. Phys. Oceanogr.* (submitted).

[3] Nakano, T., I. Kaneko and Y. Takatsuki (1990) The Kuroshio structure and transport estimated by inverse methods. Proceedings of Japan China Joint Symposium of the Cooperative Study of the Kuroshio, 14-16 November 1989, Tokyo, Japan, 58-68; Yuan, Y., M. Endoh and H. Ishizaki (1990) The study of the Kuroshio in the East China Sea and currents east of Ryukyu Islands. ibid., 39-57; Yuan, Y., J. Su and Z. Pan (1991) A study of the Kuroshio in the East China Sea and the currents east of the Ryukyu Ridge in 1988, in *Oceanography of Asian Seas*, ed. K. Takano, Elsevier, 305-319.

[4] Ishii, H. (1990) Surface current observation with drifting buoys in the Kuroshio region. Proceedings of Japan China Joint Symposium of the Cooperative Study of the Kuroshio, November 14-16, 1989, Tokyo, Japan, 28-38; Chaen, M., M. Fukasawa, A. Maeda, M. Sakurai and M. Takematsu (1992) Abyssal boundary current along the northwestern perimeter of the Philippine Basin, in *Physical and Chemical Aspects of Deep Ocean Circulation*, ed. T. Teramoto, Elsevier (in press).

[5] WOCE International Project Office (1990) WOCE PCM1 Design Workshop, Tokai University, Shimizu, Japan, 27-28 August 1990, WOCE Report No. 57/90, 24pp.

WANTED: CRUISE PLANS AND REPORTS

The WOCE Hydrographic Programme Office (WHPO) is charged with coordinating, collecting, quality controlling, and reporting on data obtained in the international WHP. To date, the WHPO is attempting to track, collect, and quality control the data from about 115 one-time cruises, 210 repeat hydrography cruises, and 6 time-series stations being done by some 30 countries and approximately 100 institutions. According to Dr Charles Corry, Coordinator of the WHPO, the task can be achieved "...if we have the wholehearted cooperation of all participants." Corry, and Dr Terrence Joyce, Director of the WHPO, are calling on chief scientists and principal investigators (PIs) to submit cruise-related documentation and data in a timely manner, as outlined in the WHPO's recent publication, "Requirements for WOCE Hydrographic Programme Data Reporting" (Joyce, T., C. Corry, and M. Stalcup, eds., 1991, WHPO Publication 90-1, 71 pp.).

Chief scientists should submit at least a preliminary cruise plan for all WHP cruises one year before the cruise, and a cruise report within one month after the cruise in order to keep the WOCE community informed of cruise objectives and accomplishments. A summary of all WHPO reports is shared with the community via OCEANIC, the WOCE Data Information Unit's (DIU) online information system.

The WHPO is the designated Data Assembly Centre (DAC) for all WHP data and independently evaluates the quality of the hydrographic data taken on WOCE cruises; to meet this task, the Office requests that chief scientists submit a copy of CTD and water sample data 6 months after the cruise and data dependent on shore-based analyses, if any, 18 months after the cruise.

A WOCE cruise is not considered complete until the data have been submitted to the WHPO and gone through a data quality evaluator (DQE) and all outstanding problems resolved between the chief scientist and the data quality evaluators. Experience to date suggests that this process greatly improves the quality of the data and the documentation of methods. While a long and often frustrating process, it is essential that the minutiae of calibrations, reagents, station locations, etc. be thoroughly documented if a uniform global data set is to be assembled at the completion of WOCE.

If changes to the data are warranted after the review process, a revised data set should be resubmitted to the WHPO by the chief scientist. That revised data set is regarded as the "final" data set that will be released to the World Data Centers at the end of the proprietary period by the WOCE Special Analysis Centre (SAC) in Hamburg.

It is particularly important that the data from any previous cruise go through the DQE process before another WOCE cruise is undertaken by the same investigators in order to avoid perpetuating any detectable errors in the methods being used for data acquisition and processing.

Software is being developed by both the WHPO and the SAC to aid in processing and editing of WHP data. For information about this software, contact either the WHPO or the SAC (addresses are given below). Such software is made available at no cost to the investigators.

Documentation provided by the chief scientist, PIs, data reviewers, and the WHPO will be combined into two reports, for ship-based and shore-based data, respectively. These reports will initially only be distributed on electronic media to the chief scientist, the PIs, the Special Analysis Centre (SAC) for WHP data, and to those recipients designated in writing by the chief scientist and the PIs. Publication of an archival version of the final report is targeted for 24 months after the cruise if no shore-based analyses were required, and 42 months for those cruises that require shore-based analyses. The data reports are assembled by the WHPO in cooperation with the chief scientist(s) and published and distributed by the SAC at no cost to the investigators.

Further details, as well as standard formats for the data and all required documentation, are given in publication WHPO 90-1, available from the WHP Office, Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA, Tel: 1-508-457-2000 ext. 3374, Fax: 1-508-457-2165, Omnet: WHP.OFFICE, Internet: ccorry@aqua.whoi.edu; or from the WOCE Special Analysis Centre, Bundesamt für Seeschiffahrt und Hydrographie, Deutsches Ozeanographisches Datenzentrum, Postfach 30 12 20, Bernhard-Nocht-Strasse 78, D-2000 Hamburg 36, Germany, Tel: 49-40-3190-3536, Fax: 49-40-3190-5000, Omnet: WOCE.WHP.SAC.

Other publications currently available from either the WHPO or SAC include the WHP Operations and Methods Manual (WHPO 91-1), and oxygen (WHPO 91-2) and CFC (WHPO 92-1) intercomparison reports.

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WHP DATA FLOW (DOES IT?)

The data flow into the WHP Office has been steady, but slower than expected. We have prepared a table (see next page) in which we have highlighted data sets in which we have some digital information at the WHPO (other than ASCII cruise plans or reports). This includes summary files (giving station locations and variables sampled), hydrographic bottle data files, and CTD data files. Data go through several stages and usually include the following steps:

- submission to WHPO, correction of formats
- data sent to DQEs for evaluation
- comments from DQEs returned to chief sci.
- revised data submitted by chief sci. ('final')
- data submitted by the WHPO to SAC

Data are not 'released' to the community until two years after the cruise for shipboard data or until the 'final' data set is submitted by the chief scientist (whichever comes later). In the case of shorebased data, they will be added to the shipboard data by the chief scientist or his/her designee together with assistance from the WHPO. We have not yet received any shorebased tracer data and so the hydrographic data referred to in the table is just those defined in our *.sea file in 90-1, such as temperature, salinity, oxygen, nutrients, CFCs, and sometimes CO_2.

As can be seen from the table, our first data set has gone all the way through the 'system', ending at the SAC in Hamburg (and thence to the WDC-A). Other data sets are in different stages of the above scenario. Data sets that are overdue are indicated. We try to keep the chief scientist alerted to the need for quick submission of these data as they often create problems with the data flow. For example, the CTD data from Siedler and Liu have been received but cannot be evaluated since the bottle data files are not present: one important aspect of the CTD evaluation is how well the CTD and bottle data agree on a station to station basis.

Common problems with WHP data

Some common problems have come up with WHP data. The first of these can occur when one group collects and processes the CTD data while another one (perhaps in a different country!) is responsible for assembling the bottle data. If there is no clear line of responsibility, problems with detection of mis- or double-trips in the CTD rosette, and correction of the bottle data (proper 'registration' with the CTD data at bottle closure) can and do cause long delays in production of a high quality data set for submission to the WHPO. Of even more concern is the delay by the chief scientist in getting a good data set out to the collaborating PIs, who have left the cruise with a raw data set full of potential problems.

A second problem, already mentioned, is the arrival of CTD data at the WHPO before the bottle data. This was not envisioned when we started; in fact we anticipated the opposite happening. This reversed order causes problems in quality control of CTD data by the DQEs. We expect that the bottle data are available to the CTD groups to calibrate the CTD salinities and oxygens as is the usual case. The delay in submission to the WHPO may be due to the requirement that the chief scientist submit a bottle data file containing all of the WHP variables measured at sea. We have received few, if any, requests for assistance from chief scientists for this 'assembly' task, which is clearly taking longer than anticipated.

A final common problem deals with data formats. We have requested chief scientists to insert '-9s' for missing data values. When these appear without a decimal point in data files, there can be problems when data are read with a fixed floating point format. Another problem occurs when data originators use a blank field. Please pad out the missing data values with zeroes to fill out the field (i.e. -9=-9.000 for f7.3). Also the PIs should be sure to let us know if the ITS-90 temperature scale is used; we have assumed so and have been surprised that, in some cases, groups are still reporting temperatures in IPTS-68. We will have to issue some revisions of 90-1 in order to clear up issues dealing with data formats. This will be done within the next year.

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Section	Ch. Sci.	Ship	Cruise/Leg	Date	Hyd file at WHPO	Hyd file to DQEs	Hyd rpt. from DQEs	Hyd file revised	Hyd data to SAC	CTD file at WHPO	CTD file to DQEs	CTD rpt. from DQEs	CTD file revised	CTD data to SAC
PRS2	Lukas	Various	HOTS 1-12	10/30/88	1/11/91	1/15/91	2/25/91	3/2/92	5/29/92	1/11/91	1/15/91	3/12/91	3/2/92	5/29/92
PR11/13N	Forbes/Church	Franklin	10_89	8/15/89	5/21/91	8/26/91	2/25/92			5/21/91	6/11/91	4/22/92		
PRS2	Lukas	Various	HOTS 13,20,22	1/7/90	3/9/92	6/1/92				3/9/92	7/29/92			
A12/S2/A21	Roether	Meteor	11_5	1/23/90	1/18/91	1/31/91	8/15/91			6/12/92	7/29/92			
PR11/13N	Forbes/Church	Franklin	2_90	2/26/90	5/21/91	8/26/91	2/25/92			5/21/91	6/11/91	4/22/92		
AR7E	van Aken	Tyro	90_3	7/2/90	3/26/91	10/15/91	2/4/92	6/5/92	8/21/92	2/11/91	2/26/91	6/20/92	7/30/92	8/21/92
AR7W	Lazier	Dawson	90_12	7/2/90	(1/15/91)					(1/15/92)				
PR19	Kaneko			11/13/90	8/18/92					8/18/92				
PR21	Liu	Ocean Res	266_2	11/16/90	none					6/23/92				
PR16	Moore	Discoverer	EPO EPOS	11/26/90	12/18/91	5/27/92				12/10/91	5/27/92			
PR18	Miyagi	Chofu Maru		1/24/91	8/18/92					8/18/92				
PRS2	Lukas	Various	HOTS 23-32	2/1/91	6/29/92	8/19/92				6/29/92	8/19/92			
A9	Siedler	Meteor	15_3	2/10/91	8/27/92					3/12/92				
P16N	Bullister	Discovery	CGC91	2/12/91	6/2/92	8/19/92				1/17/92	8/19/92			
AR7E	van Aken	Tyro	91_1	4/12/91	5/22/92	6/6/92				6/4/92	6/12/92			
AR12	Pollard	C. Darwin	58&59 VIVALDI	4/25/91	7/30/92					7/8/92				
AR7W/AR5 /A4C/A20N	Hendry	Hudson	91_7-15	4/26/91	(12/4/91)					(12/4/91)				
PR18	Aoyama	Chofu Maru		4/27/91	8/18/92					8/18/92				
P17C	Tsuchiya	T. Washing	TUNES 1	6/1/91	(1/10/92)					(1/10/92)				
P16S/17S	Swift	T. Washing	TUNES 2	7/16/91	(2/25/92)					(2/25/92)				
AR12	Gould	C. Darwin	62 CONVEX	8/1/91	7/7/92					7/7/92				
PR18	Hinata	Chofu Maru		8/3/91	8/18/92					8/18/92				
P13C	Taira	Haku Maru	915_1	8/14/91	(4/1/92)					(4/1/92)				
P16C	Talley	T. Washing	TUNES 3	9/1/91	5/12/92					(5/1/92)				
A1E	Meincke	Meteor	18_1	9/1/91	(4/1/92)					(4/1/92)				
PR18	Moriyama	Chofu Maru		10/16/91	8/18/92					8/18/92				
PR19	Moriyama	Chofu Maru		10/23/91	8/18/92					8/18/92				
AR7W	Lazier	Hudson	92_14	5/27/92	(12/15/92)					(12/15/92)				

WOCE SUBSURFACE FLOAT DAC

In March 1992 the WOCE Subsurface Float Data Assembly Centre submitted to WDC-A the historical SOFAR float data set that had been obtained by URI and WHOI scientists from 1972-1989. These consist of 230 float trajectories and 240 float years of data in the North Atlantic. The data, which are shown in Figure 1 and listed in Table 1, have recently been described in review articles by Owens (1991) and Richardson (1992).

Additional historical float data have been identified and requested by the data centre and are listed in Table 2. Some of the data are still being processed and will be available in the next year or two. The data sets will be submitted to WDC-A and made available to scientists once the data have been acquired and checked by the centre and after the principal investigators have given the centre approval to do so. Until then the originating investigators should be contacted directly for the data.

Newer WOCE float data will be requested by the data centre after the trajectories have been measured. Most WOCE floats have yet to be deployed, but we have obtained the ALACE data for 1990 and 1991 from Russ Davis.

For further information please contact Philip Richardson or Christine Wooding at WHOI (Telephone: 508-548-1400, ext. 2722, or ext. 2546, Omnet: P.RICHARDSON, Internet: cwooding@edu.whoi).

References

Owens, W.B., 1991. A statistical description of the mean circulation and eddy variability in the north-western Atlantic using SOFAR floats. *Progress in Oceanography*, **28**, 257-303.

Zemanovic, M.E., P.L. Richardson and J.F. Price, 1990. SOFAR float Mediterranean Outflow Experiment: Summary and data from 1986-1988. Woods Hole Oceanographic Institution Technical Report WHOI-90-91, 239 + iv pp.

Table 1. Summary of URI/WHOI SOFAR Float Experiments 1972-1989

Originator	Experiment[(a)]	Number of Floats	Depths (m)	Years	Approximate Location	Average Duration Days	Float Years
URI	MODE (MO)	47	1500	1972-76	28°N 70°W	178	22.9
NAVOCEANO/ WHOI	Ring (RI)	8	1100	1974-75	33°N 70°W	154	3.4
URI	PreLDE (PL)	20	700, 2000	1975-79	20-30°N, 55-75°W	586	32.1
URI	LDE (LD)	45	700, 1300	1978-79	31°N 70°W	164	20.2
WHOI/URI	LR/GS	5	700, 1300, 2000	1978-79	36°N 65°W	316	4.3
WHOI/URI	GUSREX (GU)	39	700, 2000	1980-85	24-42°N 55°W	563	60.1
WHOI	Site L (SL)	21	700	1982-85	34°N 70°W	424	24.4
WHOI	Eastern Basin (EB)	32	1100	1984-88	32°N 24°W	698	61.2
WHOI	Newfoundland Basin (NB)	13	700, 1200, 2000	1986-89	45°N 40°W	333	11.9
	Summary	230	700-2000	1972-89		381	240.3

(a) Two letters which refer to the experiment plus a number are used to identify individual floats. MODE stands for the Mid-Ocean Dynamics Experiment, Ring refers to an experiment to track Gulf Stream rings, LDFE stands for the Local Dynamics Experiment of Polymode, LR was a test of long range float tracking, GS was a test of float tracking in the Gulf Stream, GUSREX stands for the Gulf Stream Recirculation Experiment, and Site L refers to a location near 34°N 70°W where floats were launched in clusters.

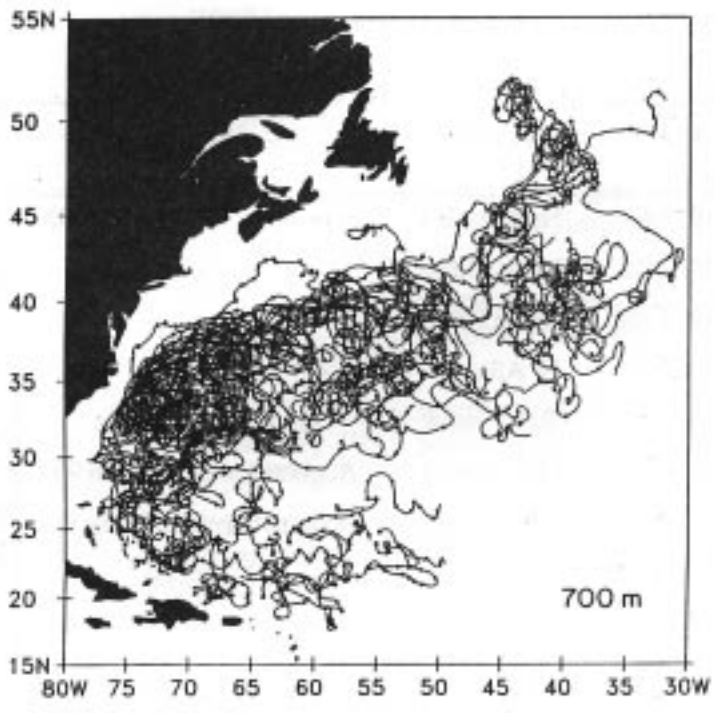

Figure 1a. Trajectories of SOFAR floats at a nominal depth of 700 m (from Owens, 1991). Arrowheads are spaced at 30-day intervals.

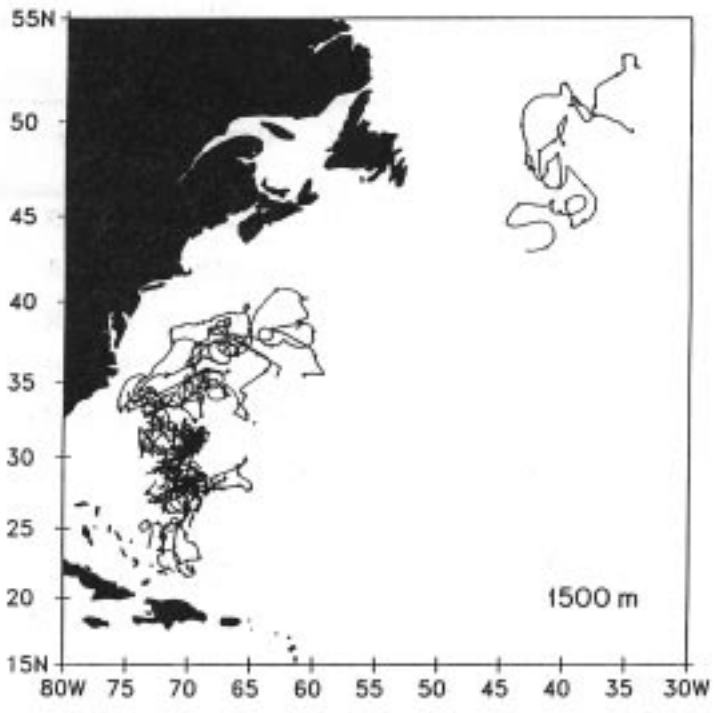

Figure 1c. Trajectories of SOFAR floats at a nominal depth of 2000 m (from Owens, 1991). Arrowheads are spaced at 30-day intervals.

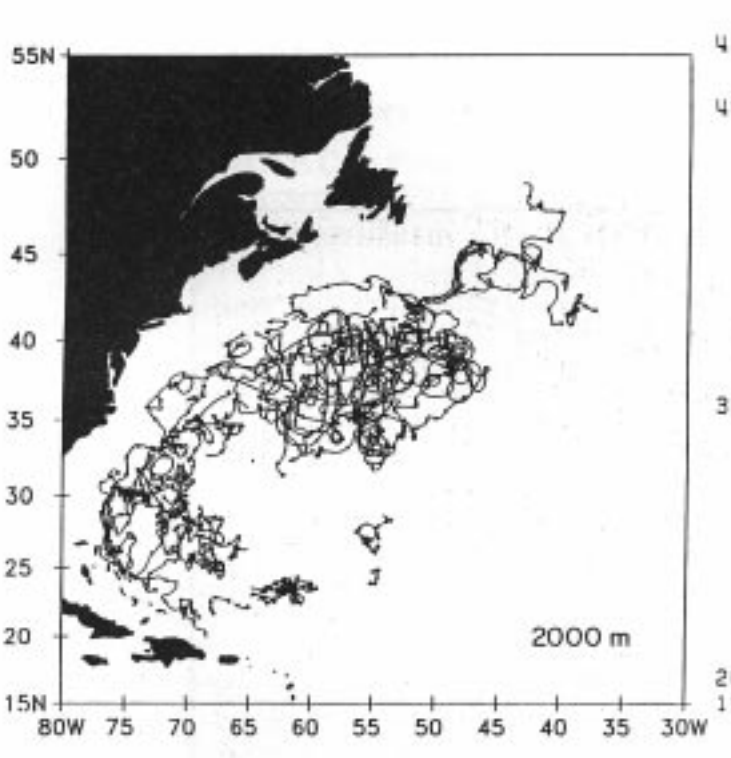

Figure 1b. Trajectories of SOFAR floats at a nominal depth of 1500 m (from Owens, 1991). Arrowheads are spaced at 30-day intervals.

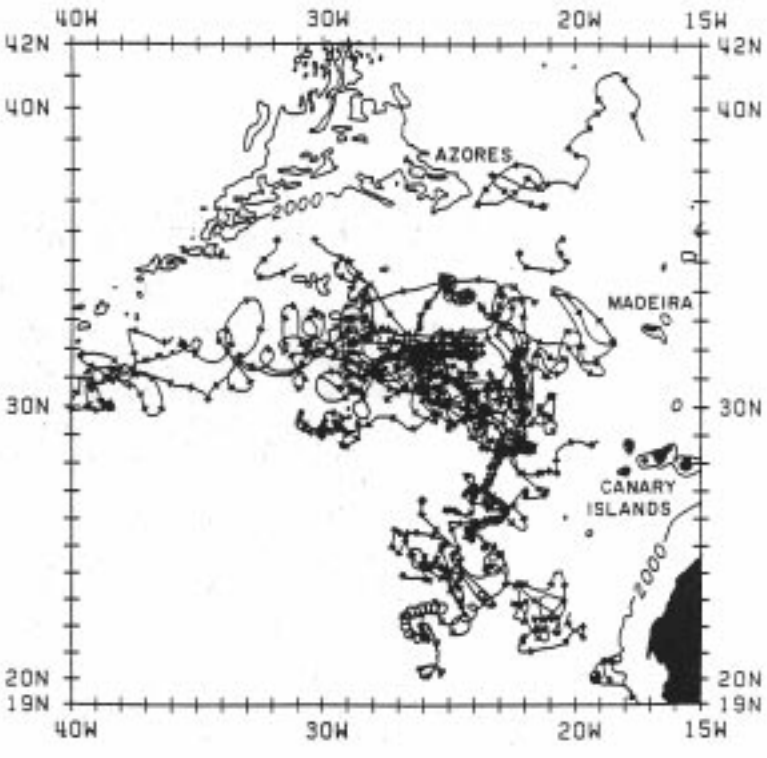

Figure 1d. Trajectories of SOFAR floats at a nominal depth of 1100 m (from Zemanovic et al., 1990). Arrowheads are spaced at 30-day intervals.

Table 2. Estimated Number of Historical Float Trajectories (<1990)

Originator	No. of Floats	Depth (m)	Type	Years	Location	Status
WHOI/URI	230	700-2000	SOFAR	1972-89	N. Atlantic	Available at WDC-A Mar 92
UK	15	3500	SOFAR	1983-88	Canary Basin	Acquired
UK	15	3500	SOFAR	1983-88	Iberian Basin	Acquired
France	30	700	SOFAR	1984-89	N. Atlantic	Requested
URI	45	100-1000	RAFOS	1984-85	Gulf Stream	Acquired, available
France/Germany	15	3800	SOFAR	1985-86	N.E. Atlantic	Acquired, available Jan 93
URI	71	100-1000	RAFOS	1988-90	Gulf Stream	Acquired, available Sep 93
URI	21	100-1000	RAFOS	1988-90	Gulf Stream	Requested
URI/UW	48	2500	RAFOS	1988-90	S. Pacific	Requested
WHOI	42	800-3300	SOFAR	1989-90	Equat. Atlantic	Acquired, available Jan 93
Total	530					

Australian AMS to begin making WOCE ^{14}C measurements

Beginning in late 1993 the Australian Lucas Heights accelerator mass spectrometer (AMS) facility should be capable of analyzing ^{14}C in seawater for non-Australian investigators at a rate of up to 1,000 samples per year. The facility is expected at that time to have an accuracy of 1%, with somewhat higher accuracies possible later in the programme. Duplicate AMS ^{14}C water samples were taken on the recent occupation of P6W in the Tasman Sea for an intercomparison between Lucas Heights and the NOS AMS facility at Woods Hole as a check on the accuracy.

The initial cost will be Australian $500 per sample. Interested parties should contact Dr Claudio Tuniz at the Australian Nuclear Science and Technology Organization, Lucas Heights Research Laboratories, New Illawarra Road, Lucas Heights, NSW, Private Mail Bag 1, Menai, NSW 2234, Australia, Telephone: 61-2-717-3493, Fax: 61-2-7179265, or via Internet: Tuniz@Nucleus.Ansto.Gov.AU.

When in operation the Lucas Heights facility should be capable of handling the WOCE requirements for AMS ^{14}C analyses for investigators outside the United States. For information on methods of sample collection and storage for AMS ^{14}C samples please see the WOCE Operations and Methods Manual (WHPO 91-1).

WOCE CALENDAR

Second TOGA/WOCE XBT Programme Planning Committee Meeting (TWXXPPC-2)
21-23 October 1992, Geneva, Switzerland
Contact: WOCE.IPO/INTL.TOGA

Eleventh WOCE Hydrographic Programme Planning Committee Meeting (WHP-11)
26-28 October 1992, Hamburg, Germany
Contact: WOCE.IPO

Fifth WOCE Data Management Committee Meeting (DMC-5)
29-30 October 1992, Hamburg, Germany
Contact: WOCE.IPO

Nineteenth WOCE Scientific Steering Group Meeting (WOCE-19)
26-28 January 1993, Southampton, UK
Contact: WOCE.IPO

North Atlantic Hydrographic Workshop/CP3-3.5 Meeting
February 1993, Hamburg, Germany
Contact: WOCE.IPO

Upper Ocean Thermal Data Assembly Centre Coordination Meeting
April 1993, Hobart, Australia
Contact: WOCE.IPO

Sixth WOCE Core Project 2 Working Group Meeting (CP2-6)
Summer 1993, Southern Hemisphere
Contact: WOCE.IPO

Sixth WOCE Core Project 3 Working Group Meeting (CP3-6)
Summer 1993, Halifax, NS, Canada
Contact: WOCE.IPO

Twelfth WOCE Hydrographic Programme Planning Committee Meeting (WHP-12)
Summer 1993
Contact: WOCE.IPO

Sixth WOCE Core Project 1 Working Group Meeting (CP1-6)
August/September 1993, Kiel, Germany
Contact: WOCE.IPO

Eighth WOCE Numerical Experimentation Group Meeting (NEG-8)
September 1993
Contact: WOCE.IPO

Sixth WOCE/TOGA Surface Velocity Programme Planning Committee Meeting (SVP-6)
October 1993, Honolulu, USA
Contact: WOCE.IPO

Twentieth WOCE Scientific Steering Group Meeting (WOCE-20)
9-11 November 1993, Tokyo, Japan
Contact: WOCE.IPO

WOCE/TOGA-COARE/JGOFS-EQ.PAC Pacific Meeting
February 1994, Hawaii, USA
Contact: WOCE.IPO

Symposium: “The South Atlantic: Present and Past Circulation”
15-19 August 1994, Bremen, Germany
Contact: G.SIEDLER, WOCE.IPO

Twenty-first WOCE Scientific Steering Group Meeting (WOCE-21)
September 1994, Kiel, Germany
Contact: WOCE.IPO

WOCE is a component of the World Climate Research Programme (WCRP), which was established by WMO and ICSU, and is carried out in association with IOC and SCOR. The scientific planning and development of WOCE is under the guidance of the JSC/CCCO Scientific Steering Group for WOCE, assisted by the WOCE International Project Office. JSC and CCCO are the main bodies of WMO-ICSU and IOC-SCOR, respectively, formulating overall WCRP scientific concepts.

The WOCE Newsletter is edited at the WOCE-IPO at IOSDL, Wormley, Godalming, Surrey, UK. Financial support is provided by the Natural Environment Research Council, UK.

We hope that colleagues will see this Newsletter as a means of reporting work in progress related to the Goals of WOCE as described in the Scientific Plan. The SSG will use it also to report progress of working groups, experiment design and models.

The editor will be pleased to send copies of the Newsletter to institutes and research scientists with an interest in WOCE or related research.